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Ironic effects in a simulated penalty shooting task: Is the negative wording in the instruction essential?

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Bakker et al. (2006) showed that following a negative instruction not to shoot near the keeper in a penalty shooting task, gaze and shots were ironically more often directed to the keeper. Here we examined whether the negative formulation in the instruction ("not") or mentioning the to-be-avoided area ("keeper") was responsible for ironic effects. Thirty-two male football players performed an indoor penalty-kick task following negatively (not-keeper) and positively (pass-keeper) worded instructions. There was no significant difference between instructions concerning the number of participants who showed ironic effects. Furthermore, regression analyses showed that both instructions affected shooting distance from the keeper to a similar degree and that duration of fixations on the keeper mediated the ironic relationships between both the negative and the positive instructions and performance (ps < .01). It is concluded that in the perceptual-motor domain mentioning what should be avoided and not necessarily the negative wording is responsible for ironic effects and that these effects are mediated by gaze behavior.

KEY WORDS: ....

Research in the field of sport psychology reveals that performance decrements may be expected if athletes use negative self-talk involving negative and self-defeating thoughts and statements (e.g., Murphy, 1994; Van Raalte et al., 1995; Woolfolk, Parrish, & Murphy, 1985). Negatively worded instructions or negative images may even lead to so-called ironic effects: someone does precisely that which s/he was instructed not to do. For example, one tends to think of a white bear when specifically instructed not to do so (Wegner, 1994; Wegner, Schneider, Carter, & White, 1987). In the perceptual-motor domain a golf player may putt the golf ball too long following the

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explicit instruction not to let that happen (Binsch, Oudejans, Bakker, & Savelsbergh, 2009; Wegner, Ansfield, & Pilloff, 1998; Woodman & Davis, 2008; cf. Beilock, Afremow, Rabe, & Carr, 2001; Janelle, 1999). Recently, Bakker, Oudejans, Binsch, and Van der Kamp (2006) investigated ironic effects in experienced association football players who shot penalties under differently worded instructions towards a screen on which video clips of a goal and keeper were presented for one second. When the football players were asked not to shoot within reach of the keeper, it appeared that gaze and shots were more often actually directed (closer) to the keeper compared to the neutral instruction condition.

A possible explanation for ironic effects is provided by the theory of ironic mental processes (Wegner, 1994), which holds that successful behavior relies on two cognitive processes: one controlled and the other automatic. In brief (for more elaborate descriptions we refer to Wegner; cf. Janelle, 1999), the automatic search process continuously scans the contents of consciousness for any trace of unwanted thoughts. When an unwanted thought is detected, the controlled system "kicks in" and replaces this item with a more appropriate task-related thought. Under certain circumstances, for instance, with a high mental load or with time pressure, the controlled replacing process, which requires attention for successful initiation, can be compromised – resulting in the manifestation of unwanted thoughts and less-than-optimal performance. For example, a football player about to take a penalty may instruct himself not to aim at the keeper. As a result, "keeper" may linger on in the system hereby undesirably drawing attention. The pressure to perform may prevent the controlled system to replace the unwanted thought with a more positive instruction ("aim at the open space"), eventually leading to a bad shot and a save by the keeper. Note that although specific instructions increase the chances on ironic behavior they do not always and automatically lead to such behavior (Binsch et al., 2009; De la Peña et al., 2008; Woodman & Davis, 2008). As an example, De la Peña et al. found that only about 20% of their participants, who performed a golf putting task, showed ironic effects, while most of the others showed overcompensation in that they putted extra short when instructed not to putt too long, or vice versa.

In the domain of thought control a negative formulation is necessary to evoke ironic effects, as it is impossible to urge someone, for example, not to think of a white bear using a positively phrased instruction. In contrast, in some perceptual-motor tasks it may be possible to induce ironic-like effects without a negatively formulated instruction. For example, in the study of Bakker et al. (2006) the ironic effects in penalty shooting could have been the

result of the negative instruction to avoid the keeper ("not-keeper") or of mentioning of the word "keeper" as the word keeper also figured prominently in the negative instruction. The mere fact of being (more) occupied with the goalkeeper through the instruction may have directed gaze as well as aiming behavior towards this (to-be-avoided) area. Thus, the main question of the current study was whether the negative formulation in the instructions ("not") or mentioning of the to-be-avoided area ("keeper") is essential in inducing ironic effects in the perceptual-motor domain.

To answer that question we investigated football players performing a penalty kick task following a negatively and positively worded instruction containing the word keeper. More specifically, players were instructed to "shoot as accurately as possible, and be particularly careful not to shoot within reach of the keeper" (not-keeper instruction), and to "shoot as accurately as possible, and be particularly careful to pass the keeper" (pass-keeper instruction). If mentioning of the word 'keeper' is decisive in inducing ironic effects one would expect similar ironic effects following both instructions, that is, football players' shooting performance would then be equally close to the keeper. If it is the negative instruction that is decisive we expect the occurrence of ironic effects only during the not-keeper condition. As this is the first time that this was investigated we had no a priori expectations regarding these two possibilities.

Furthermore, we also wished to gain more insight into the relationships between instruction, gaze behavior, and ironic performance. As it has been shown that performance in far aiming tasks is preceded by fitting gaze behavior (e.g., Deubel & Schneider, 1996; Henderson, 2003; Itti & Koch, 2001; Land & Furneaux, 1997) also when unwanted effects occur (Bakker et al., 2006; Behan & Wilson, 2008; Binsch et al., 2009), it was suggested that gaze behavior (i.e., fixations on the to-be-avoided area) is a mediator in the relationship between instructions and ironic effects (Bakker et al.; Binsch et al.). Specifically, it was suggested that specific instructions lead to longer fixations on the keeper which in turn lead to ironic performance. To investigate these relationships, we also measured gaze behavior preceding the penalty kicks and performed regression analyses between instruction (both negatively and positively worded instructions), duration of fixations on the keeper, and ironic performance following the procedure by Baron and Kenny (1986; Judd & Kenny, 1981) to test mediator effects. Most important, these analyses also provide additional information regarding our main question as to whether both negative and positive instructions lead to similar levels of ironic performance.

Method

Participants

Thirty-two male intermediate football players from a district amateur league participated (mean age = 24.2 years, SD = 7.4). On average, they had 14.6 years (SD = 10.2) of experience in football competition. All participants were actively engaged in football competition at the time of the study and practiced, on average, two times (totalling three hours) a week. The experiment was approved by the ethics committee of the research institute. Each participant gave his written informed consent before the start of actual testing.

Task and Design

Video clips of a stationary goalkeeper anticipating a penalty kick were shown on a large screen. The clips were made from the perspective of a penalty taker. The task of the participant was to take a penalty, that is, to shoot a ball lying in front of him towards the projected goal. The player was instructed to hit the screen within the 1 second that the projection lasted, hereby creating a reasonable time pressure which is suggested and found in the literature as a possible constraint to induce ironic effects (Bakker et al., 2006; Janelle, 1999; Wegner, 1994).[1] The goalkeeper shown in the video clips stood either in the center of the goal or 0.15 or 0.30 m to the left or to the right from the center of the goal, resulting in five clips, one for each position. The off-center positions of the keeper were included to induce variability of players' shot direction and, thus, to prevent that players would choose one particular corner, to which they would then shoot all balls in the exact same manner. Each of the five position clips was presented twice in one of three instruction conditions, leading to 10 trials per condition. Within each condition the 10 trials were randomized. The instructions in each of the three conditions were as follows: (1) just shoot as accurately as possible: "accurate instruction"; (2) shoot as accurately as possible, and be particularly careful not to shoot within reach of the keeper: "not-keeper instruction"; (3) shoot as accurately as possible and be particularly careful to pass the keeper: "pass-keeper instruction". What it meant to 'shoot as accurately as possible' was explained to the participants prior to testing by showing each video clip while holding the football in the larger goal space next to the keeper and close to the ground. When the keeper stood in the center of the goal the football was held successively left and right close to the goalposts and close to the ground.

As we wished to determine a baseline measure (both with respect to performance and gaze behavior) unaffected by additional instructions, the "accurate" instruction condition was always the first condition. The other two instruction conditions were counterbalanced. Note that the off-center trials only served as catch trials. Given that on one side there was a relatively large open space next to the keeper, making the choice for shooting side as well as shooting itself easy, ironic effects were not expected for these trials. Moreover, only trials with the keeper in the center position allowed for sound comparisons of performance (distance to the

[1] Pilot testing with durations of 0.8, 1 and 1.2 s (50 kicks per time condition) showed that half of the balls were too late during the 0.8 s condition apparently providing a too stringent time constraint. During the 1 s condition already almost all balls were on time, demonstrating that 1 s provided just enough time to execute the current penalty kick task.

keeper, see *Data Reduction*) among the instruction conditions.[2] Therefore, only these trials were further analyzed. Thus, only two trials were used in each condition. Relevant studies showing ironic effects in the perceptual-motor domain used only 1 trial per condition (Wegner et al., 1998; Woodman & Davis, 2008); using many trials would harm comparability. Furthermore, in search for ironic effects using less trials is probably more ecologically valid than using many trials (De la Peña et al.).

Experimental set-up

The video clips (made with a digital video camera, Sony XJ 2000) were back-projected, using a mirror and projector, on a large projection screen (2.29 × 2.27 m). The projection size of the clips was 2.20 × 1.05 m with a projected goal size of 2.00 × 0.81 m. At each presentation, lasting 1 s, the player shot a foam ball (Ø = 21 cm, 296 gram, thus, proportions comparable to those of a regular size 5 football) to the projected goal from a penalty spot located at a distance of 2.83 m from the screen. At that distance the visual angle subtended by the projected goal (height) was about 9°, hereby closely simulating the real image size of the goal and goalkeeper for a real penalty from 11 m. A Canon-XM1 video camera, connected to a JVC digital video (DV) recorder and directed at the screen, was used to record shooting performance (at 50 Hz). The video camera was attached to the ceiling at a height of 2.80 m directly above the penalty spot and aimed at the screen.

Gaze behavior was registered using an eye tracking system (Applied Science Laboratories 501, Bedford, MA) that consisted of a head-mounted scene and (infrared) eye camera. With the eye-camera, detecting the displacement between the left pupil and cornea reflex relative to a pre-calibrated 9-point grid, the visual point-of-gaze was determined and integrated into the image of the scene camera that was recorded for further analysis. The accuracy of the system was ± 1-degree visual angle. The calibration of the system was checked before each trial and if necessary the system was recalibrated (on average once per 10 trials). The eye-tracker was connected to the main computer with a 6-m long cable. The 6-meter long cable was attached to the waist of the participant with a waistband and permitted normal shooting mobility.

We used an optical switch located just behind the penalty spot to determine when the ball was hit. The optical switch consisted of an infrared light beam that was interrupted by the ball when it was kicked. This interruption was converted to a signal that was sent to a light emitting diode (LED) mounted in front of the ASL scene camera. Thus, as soon as the ball was hit, the LED turned on which was visible in the scene camera recordings.

Procedure

Participants were tested individually. After a brief general explanation of the experiment each participant provided written informed consent. The participant then completed 20

[2] The landing positions of the ball relative to the keeper are not comparable from keeper position to keeper position as the open space at one side of the keeper is much larger in the off-center trials than in the center trials. To still adhere to the task instructions a participant need not shoot as close to the post in the off-center trials as in the center trials making unambiguous interpretations in terms of ironic effects difficult.

warm-up shots to a white circle (Ø = 30 cm) on a black screen, each time projected for two seconds on the screen at different locations at ground level. After the warm-up, the participant was equipped with the eye-tracker, the eye-calibration was executed, and it was explained what it meant to 'shoot as accurately as possible'. Next the participant made 10 practice shots to randomly selected clips of goal and keeper, without further instruction. Subsequently the trials of the three experimental conditions (3 times 10 shots) were performed. Prior to each trial the instruction in question was repeated verbally. Then, a video clip was presented and the participant kicked the ball to the screen. After the ball hit the screen, the ball was collected by the experimenter and repositioned on the penalty spot. Hereafter, participants were instructed to look at certain marks left and right on the screen to verify the eye-calibration. Then the next instruction was given.

Data reduction

As mentioned, per participant only the two center trials per instruction condition were analyzed, resulting in a total data set of 192 trials (2 trials × 3 conditions × 32 participants). For each of these trials we determined shooting performance, that is, the horizontal distance of the ball (in cm) from the center of the screen (keeper) when the ball hit the projection screen. Single bitmap images were captured with Adobe Première 6.5 from the video recordings made by the scene camera. With these images X- and Y-coordinates of the landing position of the ball were digitized using Image Digitizing Software "DIDGE" (see Binsch et al, 2009). The known dimensions of the goal, that is, the height of the goalposts and the distance between the goalposts, were used for calibration.

To ensure that our analyses accounted for earlier findings (Binsch et al., 2009; De la Peña et al., 2008; Woodman & Davis, 2008) that not everyone demonstrates ironic behavior we distinguished participants who did show ironic effects from those who did not according to the following criterion: when, in the not-keeper or pass-keeper condition, the two shots in that condition landed on average at least 10 cm closer to the keeper than in the accurate condition, this was interpreted as an ironic effect.[3] This criterion, albeit arbitrary, seemed reasonable, the difference of 10 cm being just over half the standard deviation of shooting performance in the accurate condition (18.4 cm), and thus substantial. Furthermore, a shot landing 10 cm closer to the projected keeper would be tantamount to a shot more than 30 cm closer to a real keeper in a real penalty setting, thus, more than one football diameter (22 cm) closer. Thus, when participants shot on average more than 10 cm closer to the keeper in the not-keeper or pass-keeper condition (relative to the accurate condition) their performance was classified as ironic.

[3] The argument for using the average of the two trials here is that they provide a more reliable measure of performance, and thus of ironic performance, than individual trials. Note that averages were not the result of a combination of one shot closer and one shot further away from the keeper, which would have been possible. In fact, all individual shots in the ironic selection were closer to the keeper, and 88% actually met the criterion of 10 cm closer to the keeper. Furthermore, we considered taking a closer cut-off point as undesirable because we felt it would not be justified to call performance within 10 cm of the 'accurate' performance as ironic. Analyses with a cut-off point of 15 cm only led to minor changes.

For each of the participants showing ironic performance, gaze data was analyzed (frame-by-frame; 20 ms per frame) for each trial from the first moment after appearance of the video clip that the gaze was directed at the screen until the moment at which the football was kicked. Following Vickers (1992, 1996) and Williams, Davids, and Williams (1999), considering a minimal fixation duration of 100 ms (five or more video frames), the number of fixations and the fixation durations on the keeper were determined. With these numbers we computed per trial how long gaze was fixated on the keeper (in ms). A coding reliability check was carried out in which 20 randomly selected trials were coded by two different observers. The 20 trials involved 72 code changes and a total of 1224 video frames. The inter-observer agreement at the level of frames was 97.5 %

STATISTICAL ANALYSIS

A chi-square test was performed comparing the number of participants who did and did not show ironic effects in the two experimental instruction conditions (not-keeper and pass-keeper) as a first test of the question whether the negative formulation in the instruction ("not") or mentioning of the to-be-avoided area ("keeper") was responsible for the occurrence of ironic effects.

Furthermore, to further explore the ironic effects and whether they were *mediated* by fixation duration on the keeper a mediation analysis consisting of three regression analyses (cf. Baron & Kenny, 1986; Judd & Kenny, 1981) was done over the individual trials of the 13 participants who showed ironic effects, as this was our population of interest. Three individual trials were excluded from the analyses because their combination of gaze behavior and performance (fixation duration × distance from the keeper) was more than 2 standard deviations away from the overall mean, leading to analyses with 75 trials (13 participants × 2 trials × 3 instructions minus 3). Because the data included repeated measurements, the effects of fixation duration and instruction on the horizontal distance that the ball landed from the keeper (in short, distance from the keeper) were quantified using generalized estimating equations (GEE) (Liang & Zeger 1993). These regression analyses consider the measurements within participants as repeated measurement and account for this dependency. Following the approach of Baron and Kenny (1986) we used three GEE regression analyses to examine the role of fixation duration on the keeper as mediator of the relationship between the instructions and ironic performance. As a first step, the regression analyses must show that the initial variable (instruction) is significantly related to the outcome (distance from the keeper). In the current study this first regression merely confirms the classification of ironic performance, yet it is needed as a first step in the mediation analysis to be compared with the third regression. Moreover, it does provide additional insight into the degree to which both instructions induced ironic effects. The second regression analysis must show that the initial variable (instruction) is also significantly related to the expected mediator (fixation duration on the keeper). The final regression analysis must show that the mediator (fixation duration) significantly affects the outcome variable (distance from the keeper) while controlling for the effects of the initial variable (instruction). Gaze behavior can be considered a mediator when the effects of instruction on shooting performance (distance from the keeper) are zero (or at least decreased) in the final regression analysis compared to the first regression analysis.

Specifically, in the first regression analysis it was tested whether instruction (i.e., the not-keeper and the pass-keeper instructions) was correlated with distance from the keeper according to:

$$DK = \text{constant} + B_1 \cdot NK + B_2 \cdot PK$$

in which DK is the distance from the keeper (cm), NK is the not-keeper instruction (= 1; accurate and pass-keeper instructions were set at 0), PK is the pass-keeper instruction (= 1; accurate and not-keeper instructions were set at 0), and B_1 and B_2 are regression coefficients. The constant comprises the estimated average value of the shooting performance in response to the accurate instruction.

In the second regression analysis the instruction conditions were related to fixation duration on the keeper according to:

$$FD = \text{constant} + B_1 \cdot NK + B_2 \cdot PK$$

in which FD is the fixation duration (ms), NK is the not-keeper instruction and PK is the pass-keeper instruction. The constant comprises the estimated average value of the fixation duration on the keeper in response to the accurate instruction.

In the third regression analysis instruction as well as fixation duration on the keeper were related to shooting performance according to:

$$DK = \text{constant} + B_1 \cdot NK + B_2 \cdot PK + B_3 \cdot FD$$

in which DK is the distance from the keeper (cm), NK is the not-keeper instruction, PK is the pass-keeper instruction, FD is the fixation duration (ms), and $B_1 - B_3$ are regression coefficients, whereas the constant comprises the estimated average value of the shooting performance in response to the accurate instruction.[4]

For each regression model we also computed the explained variance (R^2), that is, we computed the correlation coefficient between the real outcome and the predicted outcome.

Results

Number of participants showing ironic shooting performance

Of the 32 participants, 13 participants shot the ball on average more than 10 cm closer to the keeper after the not-keeper instruction or the pass-keeper instruction or both, relative to the performance after the accurate instruction. In particular, 7 participants showed ironic shooting performance after both instructions, 2 and 4 additional participants showed ironic shooting perfor-

[4] For the sake of completeness, we also explored whether the relationship between the instructions and distance from the keeper was *moderated* by fixation duration on the keeper, that is, whether the effect of instruction on distance from the keeper is different for short fixation durations compared to long fixation durations. In a final regression analysis the interactions between both instructions and fixation duration were included in the model, yet this regression revealed no effects of the interactions, and is therefore not further reported here.

mance after only the not-keeper or pass-keeper instruction, respectively. Thus, there were 9 participants who showed ironic performance after the not-keeper instruction (23 who did not) and there were 11 participants who showed ironic shooting performance after the pass-keeper instruction (21 who did not). In short, after both experimental instructions similar numbers of participants showed ironic effects, which was confirmed by a chi-square test that did not reveal significant differences between those ratios, $\chi^2(1) = 0.29, p = .59$.

The relationships between instruction, fixation duration, and ironic shooting performance

The first regression confirmed the classification procedure: both instruction conditions significantly affected the distance that the ball landed from the keeper (Table 1, Mediation 1). The regression equation was:

$$DK = 79.65 - 19.08 \cdot NK - 17.91 \cdot PK$$

implying that in response to the accurate instruction on average balls landed almost 80 cm from the keeper. Furthermore, following both the not-keeper and pass-keeper instruction balls landed almost 20 cm closer to the keeper. Thus, both instructions affected shooting distance from the keeper to a similar degree (see regression coefficients). Together the instructions explain 50% of the variance.

The second regression analysis showed that both instruction conditions also significantly affected fixation duration on the keeper (see Table 1, Mediation 2). The regression equation was:

$$FD = 267 + 139 \cdot NK + 162 \cdot PK$$

In the accurate instruction participants fixated their gaze on average for 267 ms on the keeper. Furthermore, under the not-keeper and pass-keeper instruction they fixated the keeper 139 ms and 162 ms longer, respectively, together explaining 43% of the variance.

The third regression analysis showed that fixation duration on the keeper corrected by instruction condition affected distance from the keeper (see Table 1, Mediation 3). The regression equation was:

$$DK = 86.28 - 15.64 \cdot NK - 13.79 \cdot PK - 0.03 \cdot FD$$

The equation makes clear that irrespective of instruction distance from the keeper decreased significantly with an increase in fixation duration on the

keeper, that is, with 3 cm for every 100 ms, which indicates that fixation duration on the keeper indeed played a meditating role in inducing ironic effects. Within the range of observed durations of fixation (100-600 ms) this would result in an additional decrease of 3 to 15 cm of shooting performance. Furthermore, the not-keeper and pass-keeper instructions caused a similar significant decrease in shooting performance of almost 16 cm and 14 cm, respectively. As both instructions still continued to affect shooting distance from the keeper in the final regression analysis independent of fixation duration (see Table 1, Mediation 3), the effect of mediation is considered to be partial. Together both instructions and fixation duration explained 57% of the variance.

Overall, these analyses reveal a partial meditating role of fixation duration on the keeper when ironic shooting performance occurs. Moreover, they show that negatively as well as positively formulated instructions affect performance to a similar degree, that is, both instruction types lead to similar levels of ironic performance.

Discussion

The main aim of the present study was to find out whether the negative formulation in the instruction ("not") or mentioning of a to-be-avoided area

TABLE I
Results From The Regression Analyses Concerning The Relationships Between Instruction, Fixation Duration on and distance from the keeper

		Constant	1 Not-keeper (1) accurate and pass-keeper (0) B_1	2 Pass-keeper (1) accurate and not-keeper (0) B_2	3 Fixation duration on the keeper B_3	R^2
MEDIATION 1	Coefficient	79.67	−19.08	−17.91		0.50
Distance from	SE	4.19	3.05	2.96		
keeper	*p*-value	0.00	0.00	0.00		
MEDIATION 2	Coefficient	266.92	138.46	162.12		0.43
Fixation duration	SE	28.15	44.76	47.42		
on keeper	*p*-value	0.00	0.00	0.00		
MEDIATION 3	Coefficient	86.28	−15.64	−13.79	−0.03	0.57
Distance from	SE	4.78	2.83	3.08	0.01	
keeper	*p*-value	0.00	0.00	0.00	0.01	

Note. The actual values, standard errors (SE), and corresponding p-values are presented of the constant and the regression coefficients B_1-B_3. The constant represents the predicted average for distance from the keeper (cm) or fixation duration on the keeper (ms) in response to the accurate instruction. The proportion of the explained variance (R^2) to compare the values predicted by the GEE model and the actual values at group level is also presented.

("keeper") is responsible for the ironic effects in the perceptual-motor domain. To this aim we examined ironic effects in an indoor penalty-kick task using negatively worded (not-keeper) and positively worded (pass-keeper) instructions to induce ironic effects. Most important, ironic effects occurred not only following negatively worded instructions but also after positively worded instructions containing the word keeper. This demonstrates that mentioning the to-be-avoided area ('keeper') rather than the negative formulation ('not') is crucial in inducing ironic effects in this penalty kick task. This was corroborated by the subsequent regression analyses that further explored the relationships between instruction, duration of fixations on the keeper, and (ironic) shooting performance. The analyses revealed that both instructions led to ironic effects to a similar degree. Furthermore, they revealed that ironic effects were (partially) mediated by fixation duration on the keeper indicating that ironic effects (shots closer to the keeper) were preceded by significantly longer fixations on the keeper. This is consistent with earlier findings (Bakker et al., 2006; Binsch et al., 2009) and shows that ironic effects in the perceptual-motor domain can be affected by longer fixations on the to-be-avoided area. This provides insight into the underlying mechanisms involved in ironic effects and supports the idea that in far aiming specific instructions disrupt the attentional control in the aiming action leading to ironic gaze as well as aiming behavior (Binsch et al., 2009).

Still, it should be noted that the accurate condition was always the first condition because we needed a measure of baseline performance unaffected by the other instructions. As a consequence, during the not-keeper and pass-keeper conditions participants may have adopted another intention than just to shoot accurately. Such a change in intention would not undermine the current findings, as changes in intention are at the core of ironic effects in perceptual-motor performance. Ironic effects exist by virtue of subtle and unconscious manipulations of intentions (using verbal instructions; Wegner, 1994). For instance, when instructed to shoot accurately but to also make sure not to shoot within reach of the keeper or to pass the keeper, the intention to avoid the keeper may lead to an ironic effect. It is also known that with such dual instructions participants may choose to overcompensate (cf. Körding & Wolpert, 2006; Trommershäuser, Maloney, & Landy, 2003), that is, to shoot further away from the keeper even at the risk of shooting next to the goal. In several studies concerning golf-putting such overcompensation was also found (Beilock et al., 2001; De la Peña et al., 2008). Future studies are needed to investigate the occurrence of ironic effects as well as overcompensation in the current setting and other perceptual-motor tasks.

A question that remains is why in the current experimental circumstances some participants showed ironic effects while others did not. Apart from situational constraints, as people may react differently at different times in different settings, it is suggested that there may also be specific dispositions that are related to the vulnerability to ironic effects, such as regulatory focus (Higgins, 1997, 1998; Plessner et al., 2009), action-control (Jostmann & Koole, 2007; Kuhl, 1994) or repression (Woodman & Davis, 2008). Regulatory focus refers to different modes of self-regulation, where people may differ in whether they approach a certain task, for instance, a penalty kick with a prevention focus (don't miss) or a promotion focus (make the goal; Plessener et al.). It may be that in the current study the added instruction to 'be particularly careful' already appealed to the preferred focus of participants. In a similar fashion action control refers to mental processes involved in pursuing intentions where action-oriented people appear to perform better under pressure than state-oriented people (Jostmann & Koole). Repression refers to different coping styles in situations in which people encounter unpleasant emotions, such as anxiety. People who repress such emotions were found to show ironic effects, while others did not (Woodman & Davis). Still, that one person is more susceptible to ironic effects does not mean that this person will always show ironic effects. Similarly, that another person is less susceptible to ironic effects does not mean that this person will never show ironic effects. Future studies should examine to what degree situational constraints or personality dispositions are decisive in the occurrence of ironic effects (and overcompensation).

Furthermore, our findings should, of course, not be taken to imply that in actual penalty kicking the same results would have been found. For one, on an actual football pitch time-constraints are different from those employed here; a penalty taker has more time than one second. Furthermore, in 'real' penalty kicks there is often an interplay between the penalty taker and the goalkeeper during which both try to conceal their true movement intentions. Finally, our experiment did not even begin to approach the pressurized situations with which penalty takers are confronted when taking a decisive penalty in a nerve-racking shootout (see Jordet, Elfering-Gemser, Lemmink, &Visser, 2006). In short, the generalizability of our findings to on-field penalty taking should be viewed with caution. Still, though perhaps not representative for on-field competitive penalty taking per se, the current design, including life-like video projection and actual kicks as response, is representative for complex perceptual-motor behavior, making it appropriate to reveal more general principles underlying the (ironic) effects of

instructions on gaze and aiming behavior in tasks with a target and possible distracters (for discussion on representative design see Brunswik, 1956 and Dhami, Hertwig, & Hoffrage, 2004).

As such, the current study makes clear that in the perceptual-motor domain a negative formulation is not required to initiate ironic mental processes. Ironic effects may be triggered by negative as well as positive instructions in which the to-be-avoided area is mentioned. Apparently mentioning the keeper suffices to trigger the processes described by Wegner (1994) that may eventually lead to ironic effects. Note that no specific load was used to overload the attentional system which is claimed to be a condition for ironic effects to occur (Wegner). However, in the current study participants were urged to shoot within one second, which introduced a moderate amount of time pressure. Due to this time pressure, the mental controlling process may have failed to replace the unwanted thought or action (keeper) leading to more shots in the direction of the keeper. This would suggest that time pressure may in fact lead to ironic effects (Wegner). Specifically, it may have been the case that after visual attention was ironically drawn to the keeper as a result of the specific instructions, there was insufficient time to redirect visual attention and fixate the target, the open goal space, long enough for more accurate aiming (Bakker et al. 2006). It is well-documented that such a relatively long final fixation on the target (sometimes called 'quiet eye') is essential for good performance in far aiming tasks (e.g., de Oliveira, Oudejans, & Beek, 2006; Oudejans, van de Langenberg, & Hutter, 2002; Wilson, Vine, & Wood, 2009; for an overview see Vickers, 2007). Future studies are needed to investigate the role of the final fixation on the target as well as time pressure in ironic effects in the perceptual-motor domain.

Practically, if an ironic effect occurs it provides a hindering phenomenon for the performer, be it in sports or another task environment, which may have far reaching consequences such as losing a championship. As such, it is desirable to prevent ironic effects as much as possible. Insight into the underlying mechanisms of ironic effects may provide starting points to do that. For now it seems that, at least for aiming actions, not only negatively worded instructions but also positive ones may affect gaze behavior, or aiming behavior or both, leading to ironic effects. Generally, sport psychology research suggests that positive imagery (i.e., imagining a successful outcome) or positive self-talk (involving positive and rational thoughts and statements) are associated with successful performance (Wann, 1997), while negative imagery (i.e., imagining an unsuccessful outcome) and negative self-talk

(involving negative and self-defeating thoughts and statements) are associated with performance decrements (e.g., Beilock et al, 2001; Van Raalte et al., 1995; Woolfolk et al., 1985). It now appears that even positive wording (make sure that you pass the keeper) can prime ironic behavior. Until recently it has been suggested that it is better to avoid negatively worded instructions and, thus, to focus on what to do rather than what not to do (Bakker et al., 2006; De la Peña et al., 2008). It now seems that this important principle is not necessarily sufficient to prevent unwanted effects. The focus on what to do (e.g., pass the keeper) should be combined with the right wording involving the target (e.g., shoot in the open space), which was found by Bakker et al. to lead to the most accurate performance, as mentioning the target will draw attention, and hence, performance more in the direction of the target. Positive instructions that involve objects that should be avoided and are present in the visual field of athletes may still prime unwanted behavior, as visual attention is then ironically drawn to these to-be-avoided objects.

In short, words referring to the to-be-avoided area or behavior should be avoided in instructions altogether; just avoiding negative instructions is not sufficient. Therefore, in aiming actions coaches, trainers and athletes are advised to only use positive instructions that involve the target, such as, the open goal space in penalties, the hoop in basketball, the triple 20 or bull's eye in darts, the hole in golf putting, or the apple on the head of Wilhelm Tell's son (cf. Trommershäuser et al., 2003), so that the target rather than the to-be-avoided area will draw attention, leading to successful performance. Only such positive instructions may best guarantee that ironic effects are prevented.

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